Summary Report
of the
June 21, 2001 Salmonid Workshop
for the
CALFED Environmental Water Account

by

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Prepared for the
CALFED Science Program
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September 2001
Sacramento, California

Contents

Introduction

On June 21, 2001, the CALFED Science Program convened a workshop to explore the scientific underpinnings of 2000–2001 Environmental Water Account (EWA) actions taken to protect chinook salmon and steelhead and help stabilize water supplies. (The agenda is attached as Appendix A.) The workshop goals were to foster communication between biologists and engineers working on the EWA and to prepare for a more formal review of the EWA process to be held October 22–24, 2001.

About 60 scientists and engineers attended the workshop. Most of the attendees were agency scientists; however, stakeholder scientists also attended. (See Appendix B for list of attendees.) The attendees were selected to provide a cross section of data collectors and interpreters contributing to the information needed to allocate EWA resources and evaluating the benefits of the allocations.

This report by the EWA science advisors summarizes major points made by the presenters and questions raised during the workshop and through subsequent written communications. Presenters have had an opportunity to comment on draft versions of the report, and most of their comments are incorporated in the final report. Final responsibility for its contents lies with the authors.

The report format generally follows the agenda but is presented more as a summary of the content of the workshop than as a set of minutes. There are sections on the EWA itself; the process used by biologists and operators to allocate EWA assets; the process used to evaluate benefits; and an examination of some of the key technical components of the model used to estimate the relative effects of Delta actions on the overall numbers of juvenile salmon reaching and moving through the Delta. We also have added a section on what appears to be the conceptual model used in allocating EWA resources. Final sections provide thoughts on the overall process and suggestions for improvement including research needs.

We emphasize that, although this workshop focused on salmonids, the EWA is concerned with more than chinook salmon and steelhead. Biologists considered protection for other fish species, delta smelt and splittail in particular, as well as overall ecosystem benefits when recommending changes in project operation. For purposes of the workshop, we agreed to focus efforts on issues regarding salmonids. CALFED held a delta smelt workshop on September 7, 2001. (A separate delta smelt workshop summary report is being prepared.) We must also emphasize that this was the first year of a four-year EWA evaluation process.

The Environmental Water Account

The Environmental Water Account is part of CALFED's Water Management Program designed to protect fish using water purchased from willing sellers, thereby providing assurances that water supply delivered under baseline conditions will not be interrupted because of crises involving endangered species of fish. The EWA operates, mostly in the Delta, to restore fish populations and their supporting ecosystem in conjunction with existing regulatory actions (for example, State Water Board water quality control plans and water rights permits) and CALFED's Environmental Restoration Program.

The EWA has three tiers:

- **Tier 1.** Baseline conditions (1995 Water Quality Control Plan for the Bay-Delta, Central Valley Project Improvement Act and biological opinions.
- **Tier 2.** Use of EWA and CALFED's Ecosystem Restoration Program assets.
- **Tier 3.** Water purchases for unanticipated needs—not available in 2000–2001.

The EWA is built on the premise that water can be obtained and banked until needed for actions to protect fish and their aquatic ecosystems. Water is acquired by several methods including annual purchases from existing water rights holders and institutional arrangements that result in variable amounts of water for EWA use. The variable assets can come from relaxing one or more of the Delta water quality standards (for example, the export-inflow ratio when the ratio is controlling and project pumping capacity is available), sharing with the SWP any Anadromous Fish Restoration Plan (AFRP) water released and not pumped by the CVP, and shared access to available project pumping capacity. The assets may be stored in the ground or in surface reservoirs upstream or downstream of the Delta. The amount of water available from the variable asset category depends in part on hydrology but the expectation, based on modeling, is that about 200,000 acre-feet (af) would be available each year. This year there was roughly 330,000 af available in early October 2001, the start of the season of special concern to fish. The season of concern generally ends around July 1 when most juvenile salmonids have emigrated and delta smelt and splittail are downstream of the direct influence of project pumps in the south Delta.

This was the first year of a proposed initial four-year evaluation of the use of the Environmental Water Account to help achieve the dual goals of increased fish protection and water supply reliability. Actions taken in 2000–2001 should be viewed in that context. Information obtained in the first year is being used to improve the process in subsequent years.

Using EWA Assets

In this section we describe the process used by salmonid biologists and operators to develop recommendations for use of EWA assets. Although the biologists did not present a conceptual model of the underlying assumptions used in this process, we start with a brief representation of a possible model.

The Overarching Conceptual Model—First Year of EWA Evaluation

The model (developed by the authors and modified based on comments by reviewers) is represented by a series of assumptions about salmonids and the Delta. This model is presented to promote discussion of these assumptions and to help assess if other models are more appropriate for allocation of EWA resources.

- The primary use of EWA assets in the Delta is to protect the larger juvenile salmonids; that is, those between 70 and 300 mm through February and those larger than 110 mm starting in March. This size range includes winter-run chinook but the protection measures were not specifically designed for this race. If winter-run take approaches the yellow and red light levels, winter-run protection becomes an overriding consideration.
- Protection for juvenile steelhead is important, but not the prime driver in developing recommendations for resource allocation this year.
- During the period October 1 through April 30, delta smelt and splittail salvage is considered along with chinook salmon to develop recommendations; nevertheless, the primary season of concern for these two species is from February through June.
- The past several years of salmonid data provide a good idea of the timing of juvenile migration through the Delta; however, interannual variability is expected.
- Data taken and communicated in near-real time provide adequate information with which biologists can make recommendations for allocation of EWA assets.
- Juvenile production estimates provided by NMFS give a reasonable estimate of the numbers of juvenile winter run entering the Delta and a basis for their take limits.
- The take calculation process (including salvage estimates and pre- and post-screen losses) is an adequate representation of reality.
- The tools available for use by biologists are (a) closing the Delta Cross Channel gates; (b) reducing pumping; (c) shifting pumping between the SWP and the CVP and (d) increasing inflows to the Delta.[1]

1. Note that closing the Delta Cross Channel gates is not normally considered to be an EWA action in that the winter-run biological opinion allows up to 45 days closure during the period October 1 through January 31 and complete closure from February 1 through near the end of May. Any water supply consequences of additional gate closures for fish protection could be charged to the EWA.

- Reducing pumping for a short period will reduce losses (take) of salmonids at the pumps and in the Delta.
- As stated in the CALFED Record of Decision, water in the EWA account, used in conjunction with federal water [section 3406(b)(2) of the Central Valley Project Improvement Act, or simply b(2)], was the only water available. Once this water was gone, additional export reductions that cost water were not an option because no Tier 3 water was available in 2000–2001.
- Reducing losses of juvenile chinook in the Delta will result in more fish reaching the ocean and subsequently more adults being caught in the ocean fisheries or returning to freshwater to spawn.
- Curtailing pumping will have ecosystem benefits by making Delta flow patterns more favorable for salmonids and other organisms and increasing Delta outflow during the curtailment period. That is, reducing export pumping not only reduces direct losses but also has unquantified indirect benefits.

The EWA Asset Allocation Process

The process for allocating EWA resources for salmonid protection in 2000–2001 consisted of collecting and posting data, discussing the data in a series of conference calls, developing recommendations for the project operators, and implementing actions by the operators. From October through January, biologists and operators had a predefined decision-tree process to assist in making recommendations. Short descriptions of each component of the process follow.

Data Collection

Information used to evaluate the need for EWA actions came from a variety of sources upstream of and in the Delta.

- Rotary screw trapping on Mill, Deer, and Butte creeks, the Sutter Bypass, Knights Landing, and the San Joaquin River tributaries.
- Beach seining in the lower Sacramento River, the Sacramento River near Sacramento, and the Delta.
- Trawling at Mossdale, near Sacramento, and near Chipps Island.
- Salmonid salvage and loss estimates at the state and federal fish facilities in the south Delta. The salvage record, Chipps Island trawl, and the ocean fishery also provided sources of tag recovery data used to help determine the fate of tagged hatchery fish released upstream and within the Delta.
- Hydrological, weather and operational forecasts.

Data Posting and Dissemination

Data collectors made data available to biologists and operators by way of the Internet and conference calls. The goal was to have error-checked data available within one or two days after collection. USFWS staff analyzed the data to determine trends and DWR kept track of and presented percentages of hatchery releases lost at the pumps. In addition, biologists calculated indices for Knights Landing and Sacramento catch data. These indices are used in the decision process and used to evaluate the success of actions taken to reduce take at project intakes.

Developing Recommendations for Use of EWA Assets

CALFED's Data Assessment Team (DAT), consisting of agency biologists, stakeholders, and project operators, primarily developed recommendations. Beginning in October, the DAT convened a series of weekly conference calls to review the available biological, climatological, flow, and operational data. Conference calls were held more frequently when conditions warranted. A few aspects of these calls are worth noting.

- Agencies, stakeholders, and operators were fully represented on most calls, especially when it appeared that the DAT might recommend operational changes to address fish or water quality problems.
- Commitment to the process was demonstrated by high degree of participation in the DAT calls, even when there was more than one call per week, and occasional weekend calls.
- Data were shared orally and the participants also generally had plots of important data, including cumulative plots of the numbers of chinook juveniles estimated to have been taken at the pumps. In general, data were available on a timely basis.
- After discussing salmonid abundance and distribution, projected flows, and operations, the group developed a recommendation for operational changes. The recommendation might have been to continue project operations as planned, to reduce pumping, or to resume pumping if project pumping had already been curtailed. Before the end of January biologists and operators used a formal decision tree (Figure 1) to help develop recommendations. Although they made an effort to extend the decision tree past January, events happened so rapidly that a formal decision tree for the February through May period was not adopted. A draft February–May tree was used to help the decision process.
- A key factor in the recommendation process was the amount of water remaining in the EWA. Early in the season, the biologists made monthly estimates of future EWA water allocation with the goal of ensuring water would be available for the entire season, including protection for delta smelt and splittail.
- The conference call moderator drafted notes for distribution to the DAT email reflector for review by participants. The moderator incorporated any applicable comments and distributed final notes.

Acting on the DAT Recommendations

Typically DAT calls were made on Tuesday mornings and the biologists conveyed any recommendations to CALFED's Water Operations Management Team (WOMT) that afternoon. The WOMT consists of senior management agency (MAs: DFG, NMFS and USFWS) and project agency (PAs: USBR and DWR) representatives. On some occasions, data were not sufficient to warrant making an immediate recommendation, but there was enough information to suggest problems were developing. In such cases, the DAT and WOMT members arranged for a conference call later in the week to consider new data and decide if a recommendation should be made and acted upon.

In essentially all instances, project agencies implemented recommendations for changes in project operation made during the salmonid season. In some instances, operational constraints affected the timing of the change. For example, an export curtailment might be delayed a day or so, but the magnitude of the change was as recommended. One of the few exceptions to full implementation of a recommendation occurred when the biologists recommended a change in the point of diversion from state to federal facilities. The data supported the conclusion that shifting as much pumping as possible from the SWP to the CVP intake would reduce winter-run chinook losses. The State Water Resources Control Board denied the request based on potential adverse effects on south Delta water levels that would in turn affect landowners' ability to divert water from Delta channels.

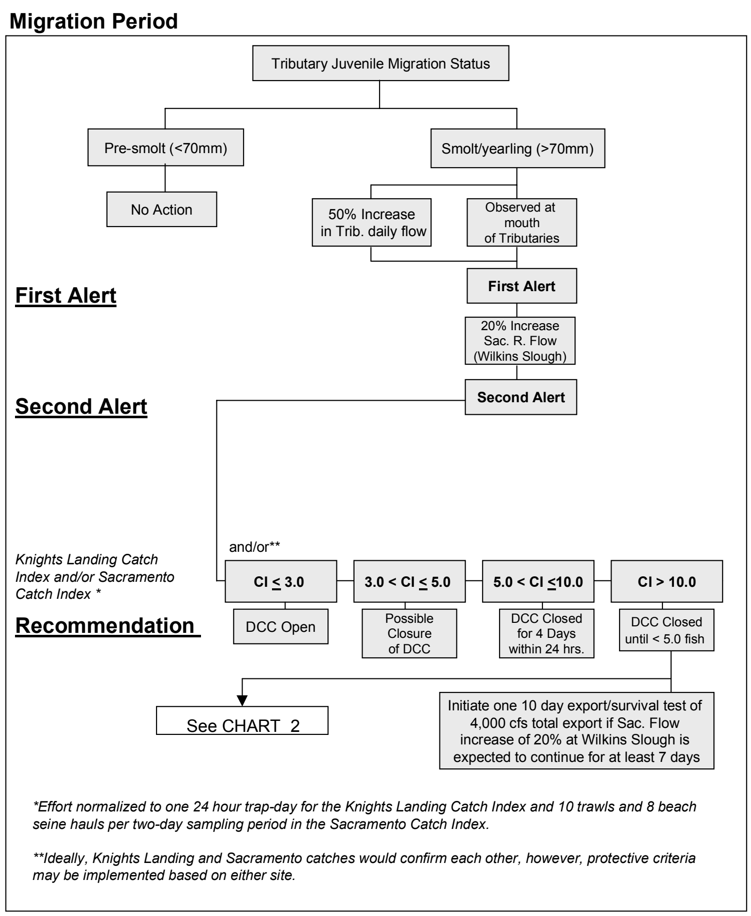

Figure 1 Fall-Winter juvenile salmon decision process, October 1 through January 31

Stakeholder Involvement in the Allocation Process

In addition to participation in DAT conference calls, stakeholders participated in two additional CALFED forums where they could obtain additional information. One of these, the Operations and Fish Forum (OFF, formerly called the "No Name Group") worked with DAT when tough issues were expected. The CALFED Operations Group (CALFED Ops) met monthly in public forum to discuss project operations including those affected by acquisition and allocation of EWA assets.

The Salmonid Take Calculation Process

In this section, deviating from the agenda, we provide background information about salmonid take at the pumps, one of the critical factors in allocating EWA resources during this past season. Take is defined as the estimated number of fish killed directly by the pumping plants, including pre-screen mortality.

In 2000–2001 the winter-run take far exceeded the specified maximum ("red light") level and the numbers and densities of winter-run juveniles taken at the federal and state salvage facilities far exceeded those observed in previous years. Because of the unexpectedly high abundance and duration of exposure to the pumps and the take exceedance, agency and stakeholder biologists initiated informal discussions of the factors involved in either setting take limits or calculating take. To broaden the discussion, and perhaps to develop recommendations for specific studies or analyses to re-examine these factors, the workshop organizing group put these topics on the agenda.

Winter-run take concerns dominated the EWA asset allocation process from about mid-February through the end of March; however, the goal during this period was to protect all chinook salmon races and steelhead. In addition to limiting direct take of wild fish, this past season biologists used another approach to protect salmonid runs—limiting the percentage of marked late-fall hatchery fish taken at the pumps. Staff at the Coleman National Fish Hatchery released known numbers of late-fall smolts near Red Bluff. The USFWS also released known numbers of marked study fish in the Delta. Release timing and fish size were about the same as for many wild late-fall, spring, and winter chinook moving downriver and through the Delta. Take of these "surrogate" juvenile salmon was limited to 0.5% of the number released.

Calculating Allowable Take at the Pumps

Three elements make up the calculation of allowable take. First is the number of juveniles estimated to be entering the Delta in any given year. Second is the take level corresponding to a given level of salvage—that is, expansion from salvage to loss, or take. Third is the allowable mortality to smolts migrating through the Delta due to direct effects of the projects—that is, take as a percentage of juvenile production.

Estimating Numbers of Juvenile Winter Run Entering the Delta

Each fall NMFS biologists, with the help of scientists from DFG, USFWS, DWR, and USBR, make the calculation called the Juvenile Production Estimate (JPE). The JPE is equal to the product of the number of winter chinook spawners, the proportion that are females, average fecundity, and the survival from eggs to fry and from fry to smolts. Each of these factors is estimated from available data. As shown below, the estimating procedure involves several assumptions. A key assumption is that all surviving smolts leave the rivers and enter the Delta.

Number of spawners. Estimating the number of spawning salmon is difficult at best and with the relatively few winter run spawning each year, it is doubly difficult. Since the late 1960s the spawning estimates have been based on the number of winter run observed ascending fish ladders at the Red Bluff Diversion Dam (RBDD). DFG biologists used direct observation and used date-specific physical condition criteria to determine if the adults were winter run, or another run.

In the past several years, biological opinions to protect winter chinook have resulted in the RBDD gates being raised during most of the period of adult upstream movement, so that the migrating adults do not ascend the fish ladders. Biologists have used past records to estimate that about 15% of the adults moved upstream after May 15, when the gates are now lowered. In recent years biologists have counted the small proportion of fish using the fish ladders and extrapolated that number for the final estimate assuming that the 15% figure holds each year. The fish ladder counts also produce estimates of sex ratio and age structure. Using these procedures in 2000 resulted in a run estimate of 1,204 naturally produced winter-run salmon.

Although the small numbers of adults and the relatively large river size limits the tools that can be used to effectively estimate run size, there are alternatives to the use of RBDD counts. At the workshop Rob Titus (DFG) reported on estimates developed from carcass surveys, a procedure DFG began to use for winter run in 1996. In 2000 field crews saw 2,482 carcasses and had a tag recovery rate (each carcass is tagged when originally found) of about 45%—about twice as high as seen in previous years. Using Petersen mark-recovery procedures, DFG applied three different models (Petersen, Schaefer, Jolly-Seber) to produce adult winter-run escapement estimates ranging from 4,227 to 6,492 adult winter run. The standard error for the adult winter-run estimate using the Petersen model was 4.2%. The effective spawner population (number of female salmon that spawned was estimated to range from 3,551 to 5,454. In comparison, the effective spawner population estimate using data from the RBDD was 517.

Steve Lindley of NMFS described a proposed new approach to provide more accurate and precise estimates of adult and juvenile abundance. His proposed method, a structural time-series or state-space model, would accommodate multiple data sources, account for differences in data quality, and provide confidence intervals for estimates. This type of model, in which better data are weighted more heavily, is generally easy to implement. The proposed work plan would involve NMFS working with a contractor or collaborator (Ken Newman at the University of Idaho) to develop and test the models and evaluate their performance. NMFS will share the results of this work with agency and stakeholder biologists. The goal is to have something to evaluate this fall in time for the 2001 spawning run.

Fecundity. NMFS biologists used recent average egg count data from the USFWS's winter-run supplementation operations at the Livingston Stone hatchery located near the base of Shasta Dam.

Sex ratio. Beginning in 1992, NMFS biologists have assumed a 1:1 sex ratio. DFG data from observed carcasses have shown an average ratio of about 4 females per male (1996–2000) with a ratio of 4.5:1 in 2000.

Survival from eggs to fry. NMFS has used a 25% egg to fry survival rate, an estimate obtained from the literature. Bruce Oppenheim stated that DFG and USFWS rotary screw trap data indicate that this may be an underestimate. Data supporting this conclusion were not presented.

Survival from fry to smolts. NMFS is using an undated estimate by DFG's Dick Hallock (retired) of 59%. Based on hatchery releases, Bruce Oppenheim suggested that this value may overestimate actual survival. Data supporting this conclusion were not presented.

Estimating Salvage and Take at the Fish Salvage Facilities

Steve Foss of Fish and Game explained the process used to estimate salvage and take of chinook salmon and steelhead.

Salvage. The salvage facilities consist of screens to separate most of the fish from the water going down the canals. The screened fish are diverted into holding tanks, where technicians periodically collect subsamples for identification and counting. The subsampling interval varies with the numbers of fish being collected and can range from as little as a few minutes every two hours to as long as one hour in a two-hour period. Technicians attempt to count fish from at least 10 minutes every two hours. Total daily salvage by species is estimated by extrapolating from these subsamples.

For juvenile chinook salmon, individual fish are assigned to race by length criteria developed originally by Frank Fisher (DFG) and modified first by Sheila Greene (DWR) to make the criteria more usable by having individual fish assigned to only one race. (The length intervals in the original criteria resulted in individuals being assigned to more than one race.) The Interagency Ecological Program's (IEP) winter-run Project Work Team later modified the criteria to more accurately reflect data on the size of winter run in the Delta. These curves are now used to assign juveniles captured in the Delta to race. However, these curves do not vary among years and therefore do not account for differences likely to result from different seasonal temperature patterns.

Technicians at the state and federal facilities also collect tissue samples for genetic analyses to help verify the actual winter-run take. The genetic sample analysis times are getting shorter but it still takes a week or longer before results are available.

Take. Salvaged fish are transferred to tanker trucks to be transported to release locations out of the direct influence of the pumps, such as Horseshoe Bend on Sherman Island. Take is the estimated difference between the number of fish entering the salvage facilities and the number released. Fish losses, described in following table, can occur at several locations in the salvage and transport process.

Table 1 Types of fish losses occurring at several locations in the salvage and transport process

Fish loss type	*Description*
Prescreen losses	Loss to predators before the fish encounter the screens. At the State Water Project, with its Clifton Court Forebay at the intake, prescreen losses are estimated to be 75%. That is, if 100 fish enter the forebay, only 25 make it to the screens. This estimate, first developed in the mid-1980s for a DWR–DFG fish mitigation agreement, is the average of the results from three experiments using releases of marked hatchery fish to estimate prescreen losses. Subsequent mark-recapture experiments in the forebay have yielded higher estimates of prescreen losses—some exceeding 90%. Prescreen losses at the intake to the CVP's Delta-Mendota Canal are set at 15%, a placeholder value that has not been verified by field experiments.
Through-screen losses	The original screens at the SWP and the existing screens at the CVP are in V-shaped configuration with louver screens (approximately 1-inch slot widths in the louvers themselves) forming the sides of the Vs. Fish enter the wide end of the V, and the louvers guide them to the narrow end of the V where they enter the pipe carrying them to a secondary screening system and then to holding tanks. Some of the fish pass through the slots in the louvers and are lost down the canals. In the late 1960s DWR and DFG conducted extensive tests to determine screen efficiency, in other words, the proportion of juvenile salmon encountering the screens that enter the holding tanks. They determined that screen efficiency is a function of fish length and flow velocity, and averages about 75% for smolt-sized fish.
Handling and trucking losses	As part of IEP's fish facilities program, DFG has conducted studies to estimate losses caused by handling the fish and trucking them to their release site. For salmonids, the losses are 2% if the fish are shorter than 100 mm total length and zero if the fish are longer than 100 mm.

Sample Loss Calculations from Salvage. The sample loss calculations below clearly demonstrate the difference that the forebay predation rate makes in the loss calculations and also indicate that changing the point of diversion is one of the tools that can be used to reduce losses, providing pumping capacity is available and assumptions underlying the differences in predation loss rates are borne out.

SWP

(1) One 90 mm salmon in a 20-minute count during a 120-minute period = salvage of 6;

(2) with screen efficiency of 75% number of salmon encountering screen was 6/0.75 = 8.8;

(3) number of salmon entering the forebay = 8.8/(1 – 0.75) = 35.2

(4) number of salmon released alive = 6 – (0.2)(6) = 5.8

(5) number lost (take) = number entering forebay – number released
= 35.2 – 5.8 = 29.3 (round to 29)

CVP[1]

(1 & 2) Assume steps 1 and 2 are the same; thus, 8.8 juvenile salmon encountered the screens.

(3) number of salmon approaching the intake = 8.8/(1 – 0.15) = 10.4

(4) number of salmon released is the same, 5.8

(5) number lost (take) = number approaching intake – number released
= 10.4 – 5.8 = 4.6 (round to 5)

Derivation of take limits. Bruce Oppenheim described the winter-run take limits and how they have evolved over time and made the following points.

- The initial combined federal and state projects' Delta winter-run chinook take limit was 1% of the JPE. Take was to be calculated from salvage using the procedures described above, with the modified Fisher growth curves providing race identification. Exceeding the take limit called for NMFS and the USBR and DWR to initiate consultation to determine additional measures to reduce direct take at the pumps. The take limits were in conjunction with other measures, such as Delta Cross Channel gate closures, designed to reduce project effects to non-jeopardy levels.
- NMFS derived the original 1% level from salvage records, which represents the historical estimated proportional loss when a DAYFLOW parameter, QWEST, was positive. QWEST is the net flow in the lower San Joaquin River calculated from a flow balance, but ignoring hydrodynamic considerations such as tidal effects. The incidental take level in itself was not a jeopardy threshold.
- In 1995 modifications to the biological opinion for CVP-SWP operations, NMFS formally recognized the uncertainty in the JPE, the size criteria and loss calculations by changing the take limit to 2% (the red light) with a 1% level (the yellow light) as a warning that project operators should be taking measures to avoid exceeding the 2% level. As in the original 1992 opinion, exceeding the 2% level initiated formal consultation—not automatic changes in the project operations.

Chronology of 2000–2001 Salmonid Actions and the Use of EWA Assets for Salmonid Protection

In this section we look at several aspects of the fall and winter salmonid emigration season and resulting EWA actions. These sections attempt to summarize several detailed presentations and capture the highlights of a complicated decision process. This section is drawn from presentations by Jeff McLain and Sheila Greene, supplemented by information from DWR's Division of Operations

1. Steve Foss did not present this calculation at the workshop.

and Maintenance (O&M). As described above, recommendations for use of EWA assets originated in the Data Assessment Team, were sanctioned by the Management Agencies (MAs: DFG, USFWS, NMFS) and once it was verified that adequate EWA assets were available to cover potential costs, were implemented by the Project Agencies (PAs: DWR and USBR). DAT biologists and operators had access to information describing fish catches by different types of sampling gear at different sites and the salvage facilities, river flows, projected operations and weather data. They also had a decision process and several years of catch and salvage data from which to evaluate 2000–2001 juvenile salmonid abundance in relation to previous years.

Although the amount of data sounds impressive, and grows each year, in reality the data are often still not adequate to accurately assess fish movement and the effects of changes in project operations on this movement (and survival). In addition, DAT members were making daily and weekly decisions based on the data in front of them and relying on a relatively limited range of past experience to attempt to anticipate future events—in other words, DAT members did not have the luxury of perfect foresight or hindsight as was available in modeling simulations forming the partial basis for the EWA.

This section examines some of the events occurring in the past juvenile salmonid emigration season, beginning with general fish occurrence and migration timing and flow, and then describes EWA actions the MAs and the PAs took to protect salmonids. The discussion first focuses on chinook salmon followed by a section on steelhead.

Juvenile Chinook Salmon Emigration

Although not a direct measurement of chinook emigration, the federal and state fish salvage facilities in the south Delta capture large numbers of juveniles and serve as round-the-clock sampling devices. The salmon salvage data (Figure 2) provide a useful picture of the abundance, timing and size of young salmon moving through the Delta. To assist DAT biologists, this graph is updated periodically through the critical emigration period. The following explanatory points may help interpret the large amount of data illustrated in Figure 2.

- Each point on the graph may represent more than one fish salvaged at either facility. The data are best used to illustrate general movement and size patterns.
- The lines on the graph encompassing specific runs are based on Sheila Greene's modification of the original Frank Fisher growth curves. The version shown has been further modified by NMFS and IEP's Winter-run Project Work Team to better reflect observed data from the Delta, mostly with respect to winter chinook. The growth curves are not adequate to quantitatively separate the four races. They do define breaks between races that would not be expected due to biological variability in spawning times and growth rates. Using the size curves, classification errors can be made in both directions. Additionally, spring-run chinook emigrating as yearlings are in the same size range as winter and late-fall runs and not represented in the size criteria.
- As with all sampling devices, the data have built-in biases. One bias may be that prescreen and though-screen losses are higher for smaller fish, thus the average size of the fish salvaged and shown in the graph may be larger than the average size of migrating salmon.

- All late-fall and winter-run hatchery fish are marked, so fish shown by black dots in Figure 2 are either wild fish or unmarked fall-run hatchery fish.

The data demonstrate that the salmonid emigration pattern is complex and protracted. Although not shown, similar graphs from other years show there is considerable interannual and intra-annual variability. Some fall, spring and late-fall yearlings came out as early as September. In November and December there was a reasonably steady, but numerically small, movement of late-fall and winter-run sized chinook. The main emigration of winter-run sized fish occurred from about February 15 through March 31. No genetically verified winter run were collected after April 15, 2001. Young fall run and spring run moved through the Delta from early February through May.

These data can also be looked at in terms of take of winter run and older juvenile salmon at the pumps, Figure 3. In this instance, salvage described in the previous figure has been converted to take (loss) by the estimation procedures described previously. Consistent with Figure 2, most of the take of winter-run and older juveniles occurred during the February through March period. This graph is updated at least weekly and distributed to the DAT email reflector. Using genetic data DWR estimated that about 80% of the calculated take of winter-run sized chinook was genetic winter run.

Flow

Juvenile salmonid movement probably responds to flow magnitude and changes (possibly because of changes in turbidity) in the watershed. In Mill and Deer creeks and elsewhere, increased flow and turbidity, often occurring together, have frequently been associated with initiation of downstream movement by juvenile salmon. High flows early in the season can start juvenile salmon migrating towards the Delta. Still higher flows can bring chinook fry into the Delta as well.

The past winter was one of the driest on record and combined Sacramento-San Joaquin river peak daily flows never exceeded about 50,000 cfs, with the average being generally less than 20,000 cfs (bottom panel of Figure 2). Modest magnitude flow increases lasting only brief periods caused downstream migration (top panels, Figure 4a) to begin but it was not sustained. Substantial numbers of juvenile chinook did not arrive in the Delta until February 2001, due to low flows in the fall and early winter of 2000–2001.

EWA Salmon Actions

During October 2000 through April, the DAT recommended six EWA actions to protect chinook salmon, most of which were expected to benefit steelhead and delta smelt. Figure 4 (shown in three panels: a, b, and c) displays a variety of information related to the EWA salmon actions. For each action, agency biologists prepared a brief written description of the action, the basis for the action, and the water costs. (See Appendix C for a description of Fish Action 2, a typical example prepared by the biologists and operators.) The October through January decision tree, including triggers, is found in Figure 1. Below we excerpt relevant information from each described action.

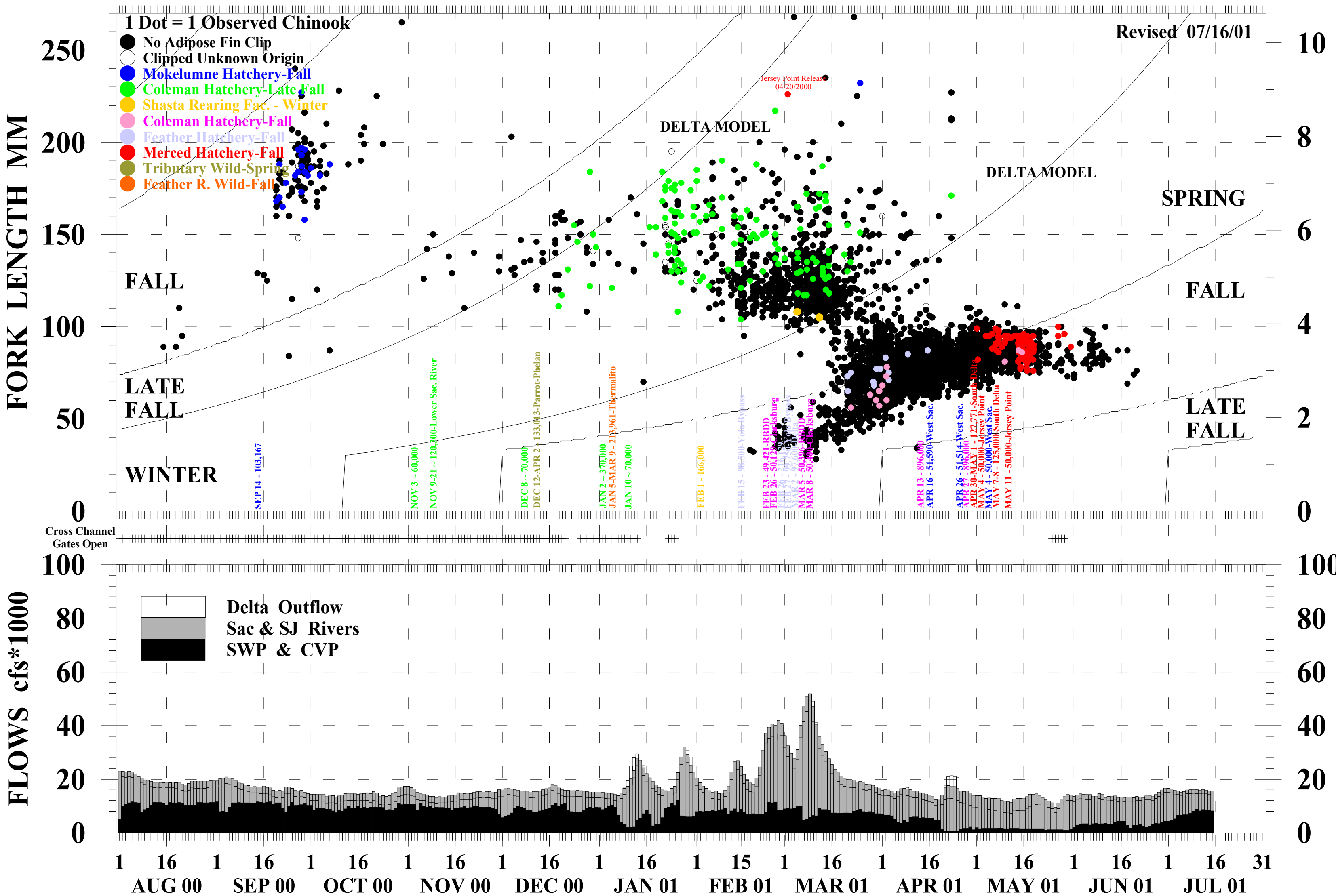

Figure 2 Observed chinook salvage at the SWP and CVP, August 1, 2000 through July 15, 2001

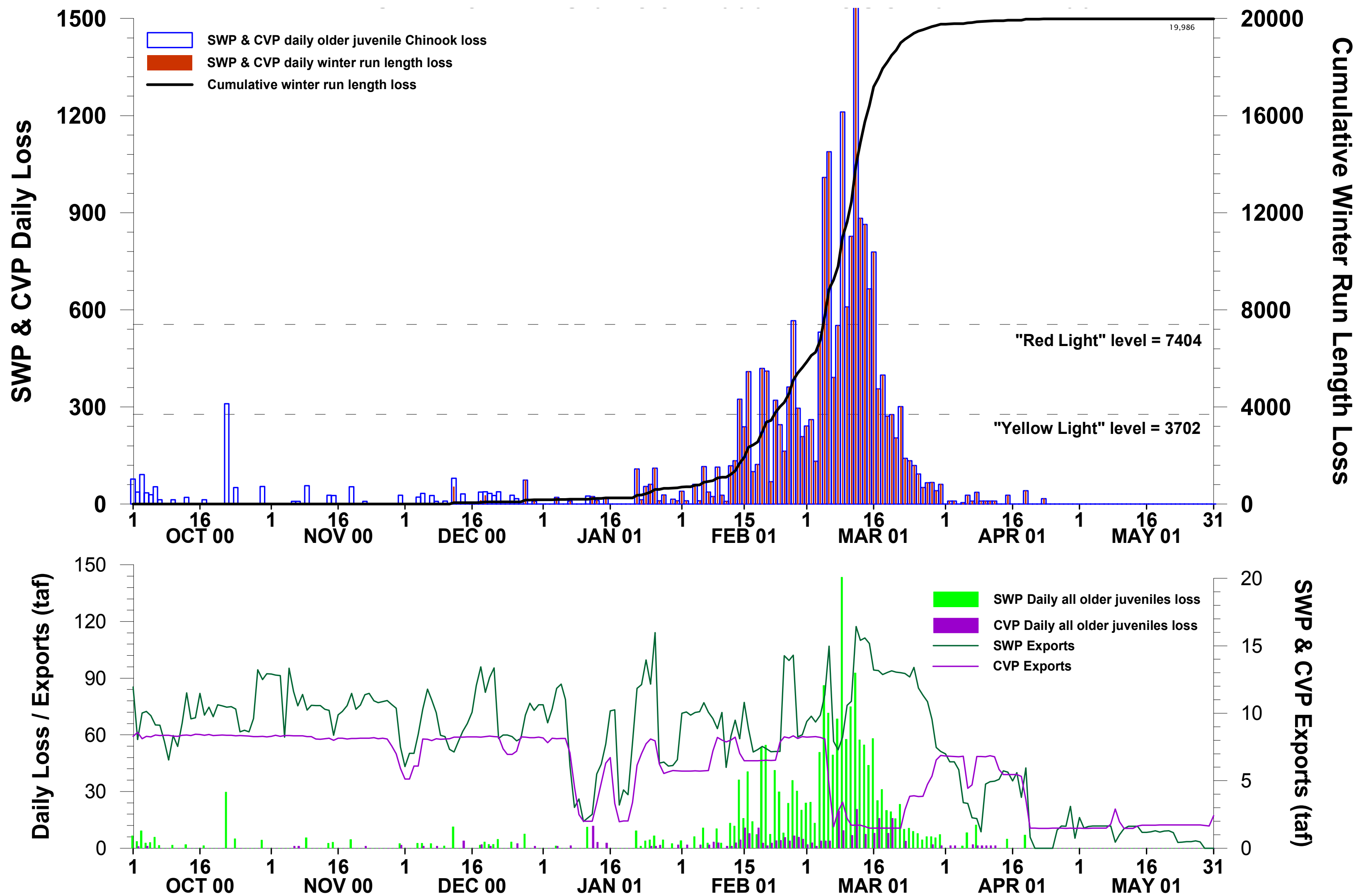

Figure 3 Winter run and older juvenile chinook loss at the SWP and CVP, October 1, 2000 through May 31, 2001

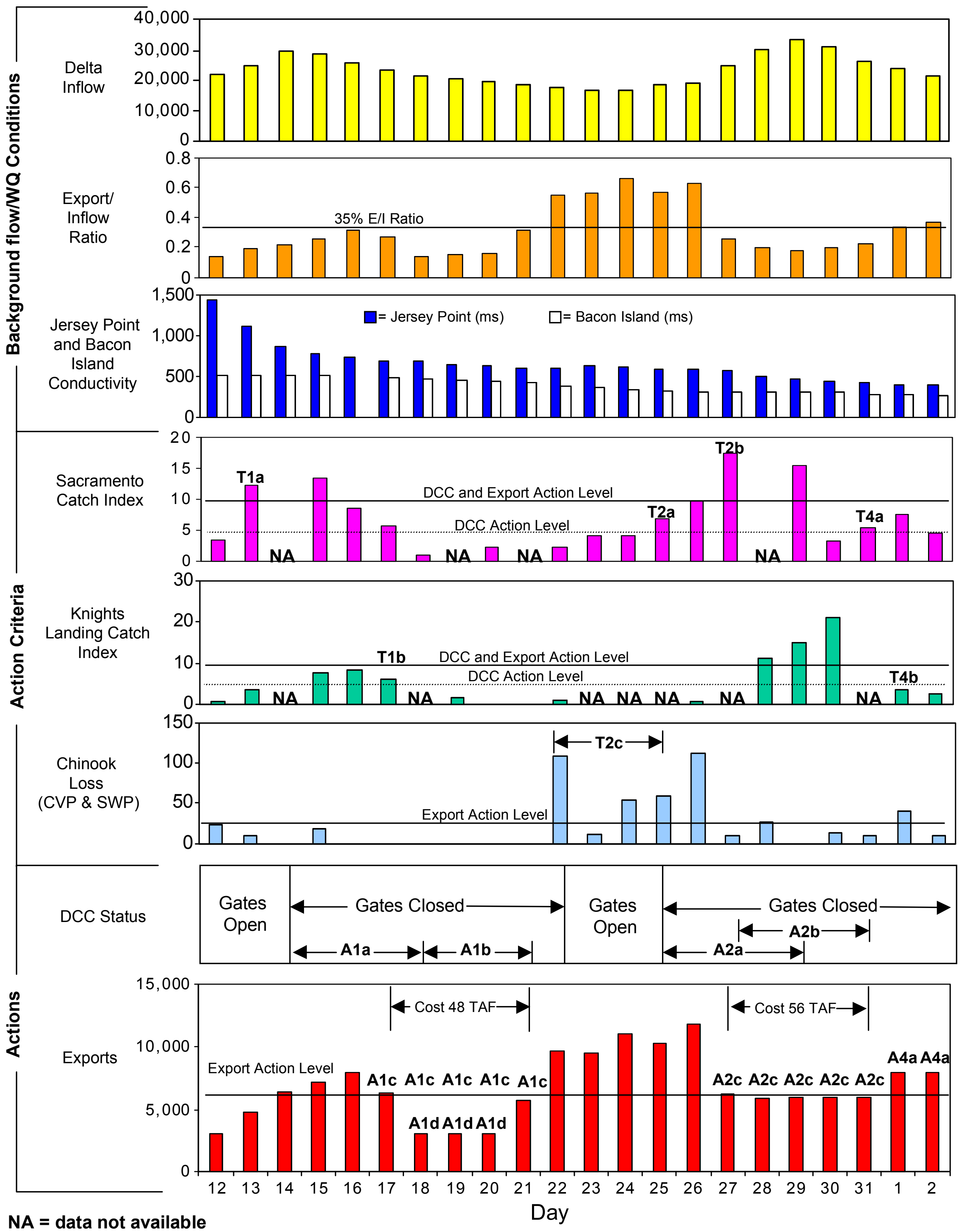

Figure 4a Delta inflow, export-import ratio, water quality, Sacramento and Knights Landing catch indices, chinook loss, Delta Cross Channel status, exports, and triggers and actions: January 12 to February 2, 2001

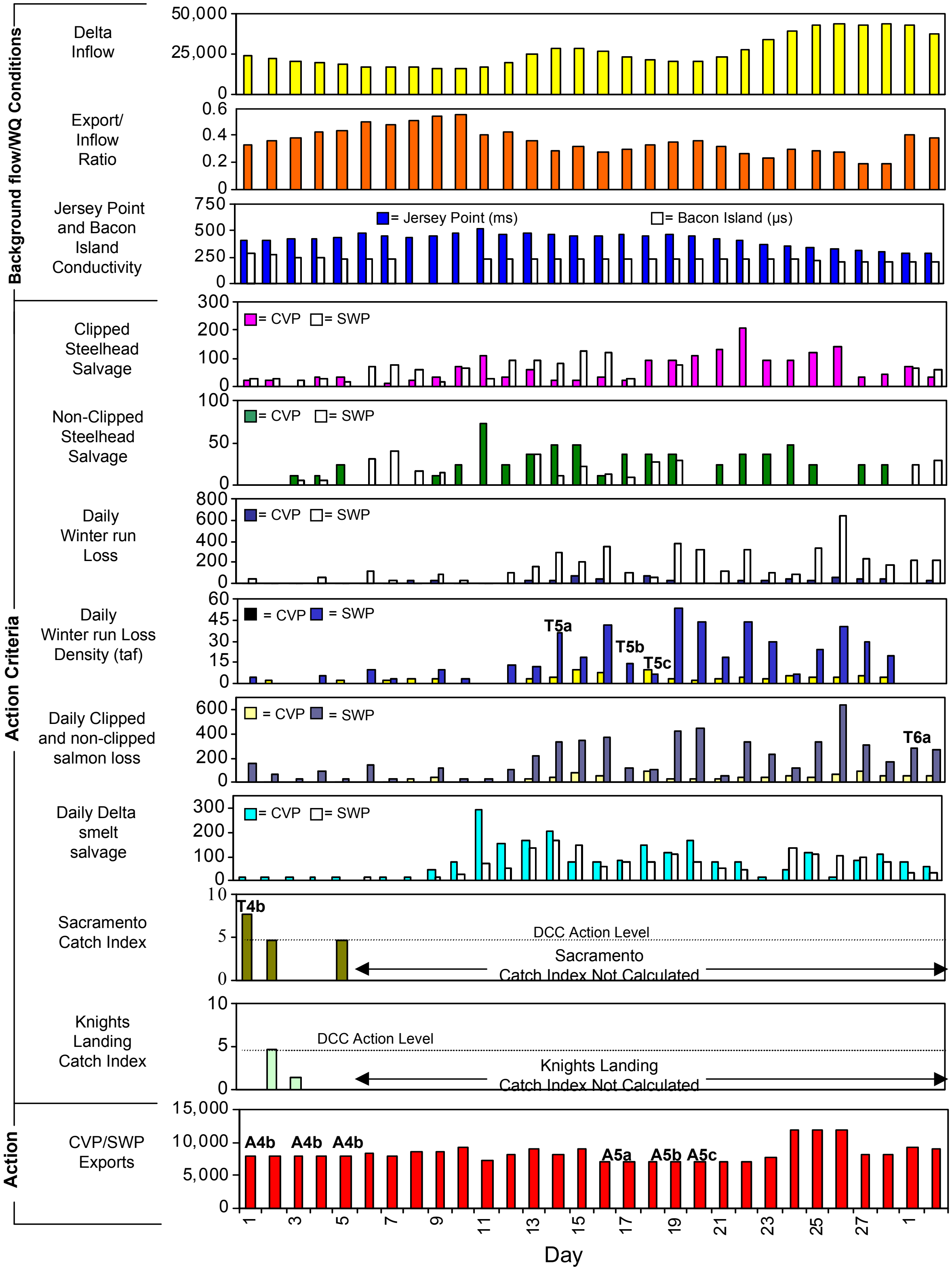

Figure 4b EWA Use Chart: February 1, 2001, to March 2, 2001

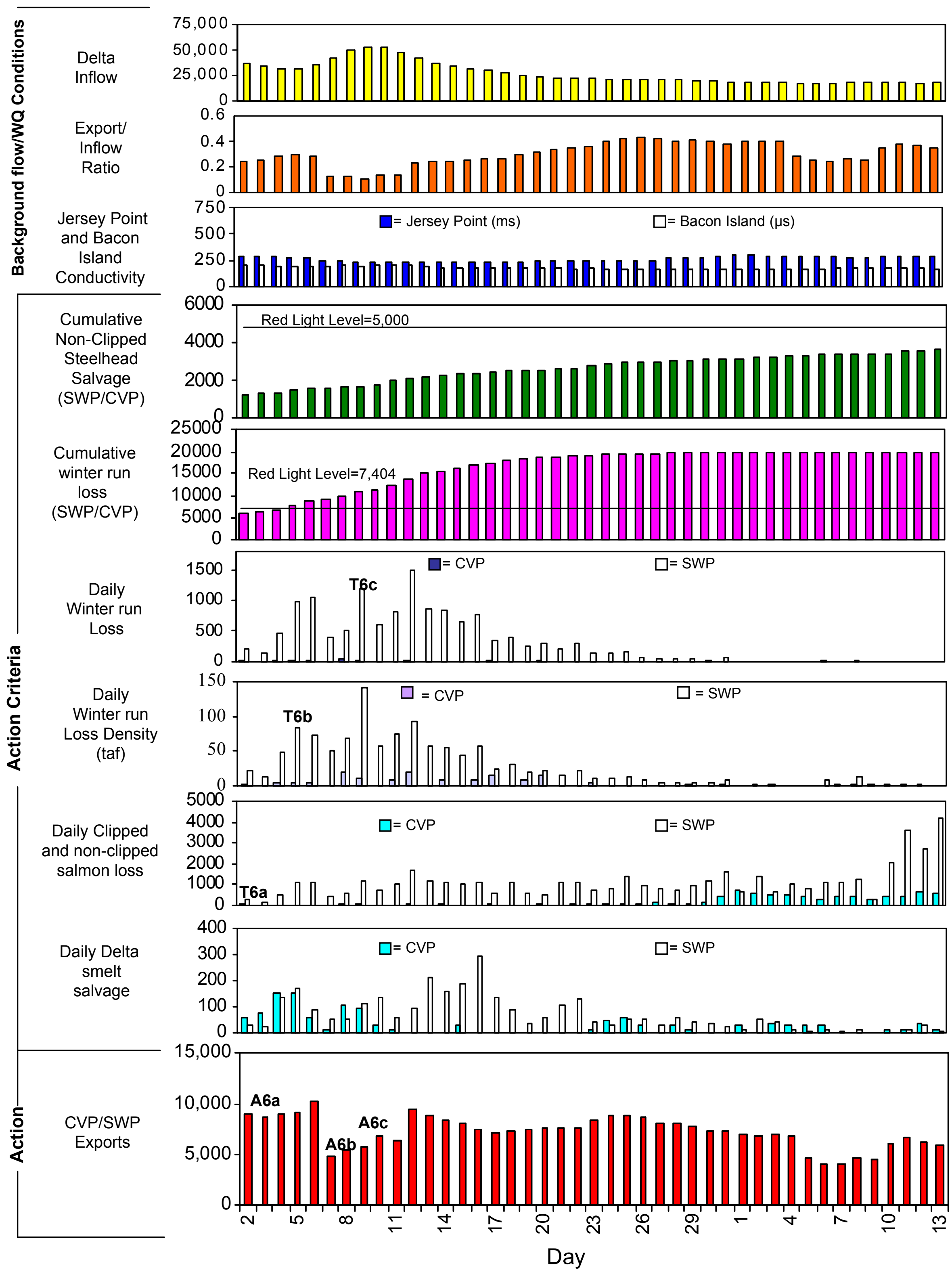

Figure 4c EWA Use Chart: March 2, 2001, to April 13, 2001

Fish Action 1

- The action: Reduce exports from an estimated 8,000 to 10,000 cfs base to a combined 6,000 cfs.
- Duration of action: January 17 through January 21.
- Purpose of action: Improve survival of juvenile salmon through the Delta.
- Trigger used: Sacramento and Knights Landing catch indices exceeded 10.
- Delta Cross Channel gates: Gates were closed on January 14, opened January 22 (not an EWA action).
- Ancillary action: USFWS requested an additional curtailment to 3,000 cfs for three of the five days for experimental purposes (a mark-recapture study).
- Use of b(2) water: Federal CVPIA b(2) water was authorized for this action.
- Estimated EWA water cost: 48,000 af.

Fish Action 2

- The action: Reduce exports from an estimated 11,600 to 11,900 cfs base to a combined 6000 cfs.
- Duration of action: January 27 through January 31.
- Purpose of action: Reduce loss of juvenile salmon and steelhead at the projects' Delta diversions and to otherwise improve survival of juvenile salmon and steelhead.
- Trigger used: Daily losses of juvenile chinook at the salvage facilities exceeded 25.
- Delta Cross Channel gates: Gates were closed on January 26 and remained closed through May 20. (Gate closure from February 1 through May 20 is mandatory.)
- Use of b(2) water: The MAs concluded that this may be a joint EWA–b(2) action.
- Estimated EWA water cost: 44,000 af.

Fish Action 3

Although included numerically in the sequence of actions, this proposed action would have been on the American River and not in the Delta. The action did occur but, as originally planned, water costs were covered through the CVPIA's b(2) program. EWA had agreed to backstop the costs in case b(2) was reduced from 800,000 af to 600,000 af due to hydrology. The action is mentioned here because not all future EWA actions will occur in the Delta.

Fish Action 4

- The action: Reduce exports from an expected base of about 10,500 cfs to a combined 8,000 cfs.
- Duration of action: February 1 through February 5.
- Trigger used: High salmon catches at Knights Landing.
- Purpose of action: Reduce adverse effects on mostly spring and winter juveniles moving through the Delta.
- Delta Cross Channel gates: Gates were closed as part of base case.
- Use of b(2) water: Reductions to occur at SWP only—no b(2) involvement.
- Estimated EWA water cost: 20,000 af.

Fish Action 5

- The action: Reduce exports from an expected combined base of about 10,500 cfs to a combined 6,000 cfs for 7 days and to 7,000 cfs for 1 day.
- Duration of action: February 16 through February 23.
- Triggers used: High salmon salvage densities (near winter-run yellow-light level), increased delta smelt in the salvage, and high salvage of unmarked steelhead.
- Purpose of action: Reduce loss rate of juvenile winter chinook, steelhead, and delta smelt.
- Use of b(2) water: Reductions to occur at SWP only—no b(2) involvement.
- Estimated EWA water cost: 39,000 af.

Fish Action 6

- The action: As shown in figure 5c, export reduction occurred in three stages.
- Duration of action: March 1 through March 11.
- Triggers used: Continued high winter run salvage.
- Purpose of action: Reduce winter run losses at the project pumps.
- Use of b(2) water: No b(2) water used.
- Estimated EWA water cost: 65,000 af.

Figure 5 provides the latest calculation of EWA water used for the period from October 2000 through June 2001. (Tracy Pettit of DWR's O&M provided these data subsequent to the workshop.) As shown, about 232,000 af of EWA water were used for salmon, steelhead, and delta smelt protection during from January through April 2001, with most of these resources devoted to chinook salmon.

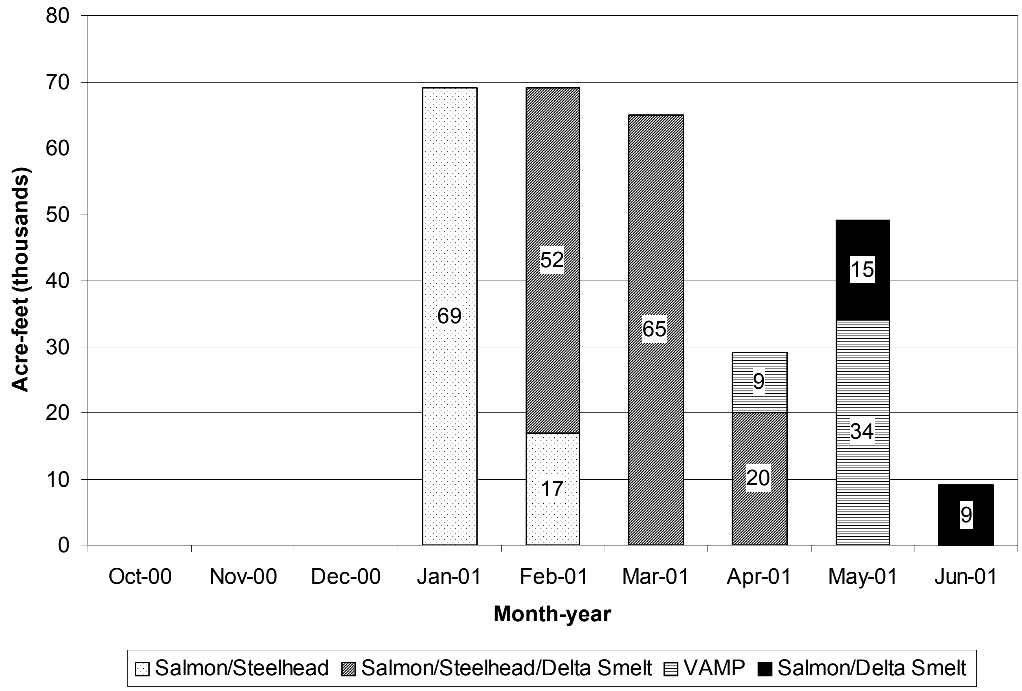

Figure 5 Water year 2000–2001 EWA expenditures for fish actions

Benefits of EWA Actions

There was little about the quantitative benefits of EWA actions in the written descriptions and in workshop presentations. Sheila Greene presented a rough calculation that curtailments had reduced winter-run take by about 5,000 fish.

Although not attributable solely to EWA actions, the take of tagged late-fall run chinook from the Coleman National Fish Hatchery never exceed the allowable 0.5% (Table 2).

Table 2 Estimated losses of hatchery late fall chinook at the SWP and CVP intakes, data through April 23, 2001

Release site	*Release date*	*Release number*	*Loss at pumps*	*%LossS*
Battle Creek	11/3/00	60,000	67	0.11
Walnut Grove	11/9/00	120,300	386	0.32
Battle Creek	12/4/00	70,000	147	0.21
Battle Creek	1/5/01	420,000	1421	0.34
Battle Creek	1/7/01	70,000	235	0.34
North Delta	1/20/01 to 1/22/01	170,000	465	0.27

Pat Brandes and BJ Miller presented spreadsheet models that could be used to assess the benefits of curtailments and other Delta actions, but did not present results. The spreadsheet models appear to offer a quick means of assessing the effects of Delta actions. The models use relations between survival and such independent variables as flow, flow splits, project pumping, and Delta Cross Channel gate operations to predict effects of operations—thus, these models are only as good as the underlying data, relationships, and assumptions.

Both models are based on the results of USFWS mark-recapture experiments. Results presented by Pat Brandes suggested survival of smolts migrating down the Sacramento River is reduced by high exports; however, these results were not subjected to rigorous statistical analysis. BJ Miller's main point was that using Ken Newman's more sophisticated analysis of the mark-recapture results, the effect of EWA export curtailments on survival (and therefore presumably recruitment to the ocean) should be very small. He emphasized that this critical point needs to be investigated further, since there may be more effective ways to use the water.

Pat Brandes also presented the results of analyses of coded wire tag recovery studies used to evaluate the survival of marked chinook salmon released at sites above and below the Delta Cross Channel and in the interior Delta. Using paired t-test statistics, she concluded that salmon released above the cross channel survived at a lower rate than those released in the Sacramento River below the gates or in the interior Delta. Lower survival was generally found even when the gates were closed, probably because fish entered the interior Delta through Georgiana Slough. Pat also used tag recovery data to conclude that project diversions affected survival, especially at rates above about 6,000 cfs. As she put it, "At higher pumping levels, exports can limit survival: at the lower levels, other factors may be more important." Figure 6 provides an example of the data used to evaluate the effects of project pumping on survival of salmon smolts moving through the Delta. Finally she described the Newman-Rice model as described in IEP Technical Report 59 (IEP 1997). This, and the updated generalized linear model, were used by the authors to evaluate factors affecting salmonid survival through the Delta. The Newman-Rice results generally supported the importance of the cross channel gates but pumping was not an important variable. Flow and salinity were both positively related to increased survival.

Although these results and models help biologists and operators evaluate the benefits of EWA actions, the analyses remain semi-quantitative.

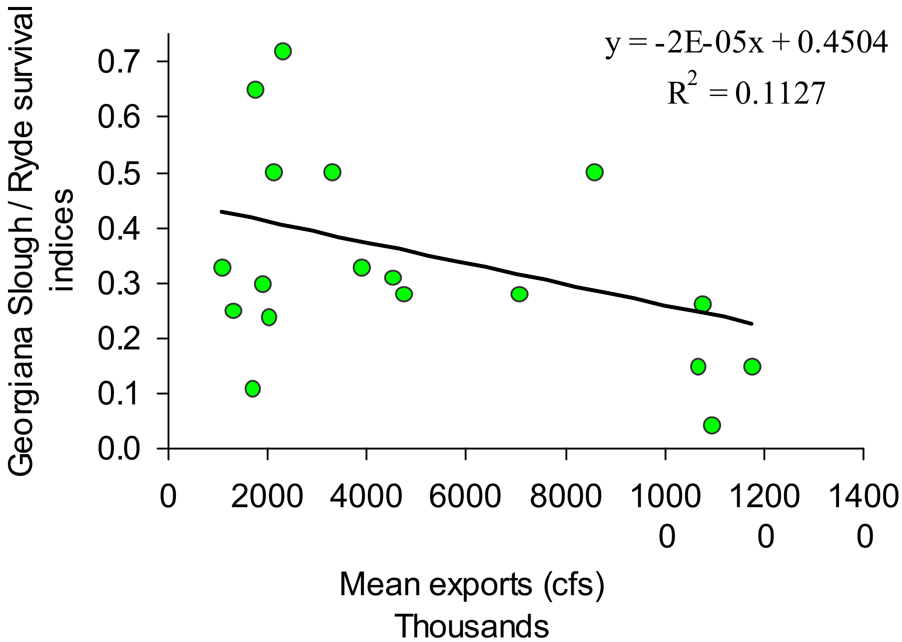

Figure 6 Relationship of survival indices to Chipps Island for CWT late fall yearlings and fall-run smolts released into Georgiana Slough relative to those released at Ryde versus combined CVP+SWP exports from release date to 17 days later

Steelhead

Jim White opened the workshop with an overview of the EWA and its implementation. He indicated that steelhead salvage in recent years has been highly variable and episodes of peak entrainment in project intakes typically has been short, thus patterns of steelhead salvage are very difficult to predict. As shown in Figure 4c, combined salvage of non-clipped (wild) steelhead through mid-April numbered around 4,000, below the red-light level of 5,000 fish. These are salvage numbers; data are not available to convert steelhead salvage to loss.

Discussion and Recommendations

This section is based on comments and questions from the audience during the workshop and written comments submitted by several of the attendees after the workshop. The discussion is grouped into a series of topics and within each topic is an admixture of thoughts from the attendees and the authors. Although there is no particular priority inherent among the topics, the first ones may be more significant.

Did the EWA Work?

As used in 2000–2001, EWA assets did not prevent estimated winter-run take from escalating to about three times the prescribed 2% red-light level. Information presented by DFG indicated that the JPE may have underestimated the number of 2000–2001 winter-run outmigrants. Workshop attendees emphasized that this was the first year of a four-year experiment and therefore too soon to determine if the EWA works. Lessons learned from each season will be used to improve the asset allocation process in later years. At the end of four years, the MAs and PAs, stakeholders, and a review panel will develop recommendations of the efficacy of continued use of the EWA to protect environmental resources and help achieve CALFED restoration and recovery goals.

Needs for New Tools

In this instance tools are those resources, actions, or guidelines that could be used in the EWA process to help salmonids. A few tools were not available in 2000–2001, but could be helpful in the future.

Tier 3 assets. Tier 3 could have provided additional resources. We assume that, as described in the CALFED Record of Decision, Tier 3 will be available in 2001–2002 and subsequent years.

Interchangeable point of diversion. This year it would have helped to be able to shift pumping from the SWP to the CVP intake. The MAs and PAs will be working with the Water Resource Control Board and South Delta agricultural interests to make this tool available.

A February through May decision tree. This tree is in draft form and should be completed before the next outmigration season.

Models. From the presentations it appears that salmonid biologists are not making full use of conceptual, hydrodynamic, statistical, and population modeling techniques in their analytical and decision-making processes. Working with CALFED, salmonid scientists should consider holding one or more workshops devoted to conceptual and mechanistic models of salmon populations, including their use of the Delta.

Adaptive management. As implemented during the past season, EWA asset allocation was not conducted in a way in which biologists and operators could use collected data to fully meet a rigorous adaptive management design. The data collected were adequate to determine that the measures implemented were not reducing winter run take to the desired level. A performance measures team established by CALFED did not get off the ground and contribute information to evaluate, among other things, consequences of EWA actions not directly related to take. The agency biologists should consider structuring part of the 2001–2002 season around an adaptive management experiment.

Decision theory. Although the October through January decision tree was a good start, DAT and CALFED managers might be able to take advantage of some of the concepts embodied in the relatively new field of decision theory.

Additional staff resources. It is clear that there is not enough sufficiently trained staff available to keep adequate track of the data, conduct the needed analyses, and make the analyses available in a variety of peer-reviewed formats. More staff is needed; and all staff will require time for training in advanced analytical techniques and time to think, analyze and write. Agency staff should also consider using CALFED's contract with the California Sea Grant Program to bring on research fellows to analyze and report on the information potentially available in specific data bases.

Genetic information. Genetic data help biologists better understand run timing through the Delta. Thus genetic analyses should be continued and the time interval between sampling and reporting be decreased. This is not an easy task and involves the resolution of a wide range of sampling, tissue archiving, analytical and reporting issues. The good news is that the analyses and markers themselves have been well worked out for winter run, and to a lesser extent, for spring run.

Data Reliability

Many of the comments made during and after the meeting addressed the adequacy of the data used by DAT to make their recommendations. Some of the key components of these concerns are outlined below.

Estimates of the numbers of juvenile winter run estimated to be reaching the Delta each year. The presentation by DFG clearly indicated that NMFS must rethink its procedures for calculating the JPE. Each of the elements of this calculation is open to question. The number of adults and the sex ratio of the spawners differed widely in alternative estimates. Survival from eggs to fry and from fry to smolts is based on old information. The analyses now apply to winter run, and the resource agencies should consider similar analyses for the other races and for steelhead. One of the commenters suggested we rely less on the production estimates and more on direct estimates (by screw traps, for example) of juvenile abundance and timing of their emigration. In reality we need a combination of these approaches to the same problem. The modeling approach described by Steve Lindley of NMFS appears to have to take advantage of many data sets and can provide confidence limits around the estimates. In all cases it is important that biologists continuously evaluate their procedures in light of new data and make adjustments as appropriate.

Catches at screw traps, beach seines and trawling. These data are invaluable to DAT biologists in developing their recommendations. To be even more useful, more effort should be devoted to standardizing methods to allow evaluation of interannual variation. The data gatherers should minimize problems such as the lack of catch indices for Knights Landing and Sacramento sampling stations—a problem that occurred this year during a critical period. Some breaks in sampling are inevitable but increased resources (boats, staff, and money) would reduce the number of data gaps. Jeff McClain suggested that the Knights Landing and Sacramento indices be merged next year to provide one index.

Salvage and take at the pumps. These data are used by DAT to determine how well they are doing at limiting direct take at the federal and state pumping plants in the south Delta. Take is estimated from salvage as modified by several assumptions about how well juvenile salmonids survive the entrainment and salvage process. One commenter noted that these problems are inherent in the present screening system, however new screens being considered in the south Delta will resolve at least some of them. The likely effects of new screens may need to be considered in long-term evaluations of the EWA.

- **Salvage.** Technicians estimate salvage by periodically identifying the numbers of juvenile salmon in the holding tanks. Although there are significant shortcomings of this process, it may be the best that can be done considering staff limitations, the inherent variability in the numbers of fish entering the holding tanks, and the need to avoid overcrowding fish in the holding tanks and transport vehicles.

- **Through-screen losses.** DFG and DWR staff used extensive field studies in the late 1960s to estimate the percentages of young salmon going through the louver screens. There is no reason to believe that new studies would provide significantly different estimates. The investigators did not evaluate screen efficiency for juvenile steelhead, so we currently rely on chinook salmon equations to evaluate steelhead losses.

- **Handling and hauling losses.** These data came from recent experiments designed and conducted by DFG biologists. There is no reason to change them. As with through-screen losses, steelhead was not tested in these experiments.

- **Prescreen losses.** This is the most significant factor in calculating salmon take at the intake to the State Water Project. The current calculation, based on early mark-recapture studies is that 3 of 4 juvenile salmon are lost to striped bass and other predators in Clifton Court Forebay and the intake channel leading to the screen bays. Subsequent studies have shown that often more than 90% of marked hatchery salmon released near the forebay intake do not make it to the screening and salvage system. The prescreen loss rate for the CVP intake is 15%—a number not confirmed by field studies.

  Many workshop participants believed loss rates for both the CVP and SWP were too low. However, one has to consider the effects of an increased loss rate on the calculated percentage of a race taken. For example, increasing the forebay loss rate from 75% to 90%, as recommended by some attendees, means that in the 2000–2001 season about 50,000 juvenile winter run were lost directly at the SWP intake. Although this number is possible, it means that, based on past estimates of the proportion of Sacramento salmon reaching the pumps, the winter chinook emigration was much larger than had been estimated or the effect of pumping was much greater than has been observed in the past.

  It may be useful to convene a workshop to evaluate available screw trap data from the Sacramento River, trawl catches at Sacramento and Chipps Island, and the results of prescreen loss studies, and determine if the rates are reasonable. Another workshop objective could be to design a different experimental and analytical approach to the question.

- **Post-release losses.** There is no post-release component of the loss calculation. Although it makes sense that post-release survival of juvenile salmonids trucked to release locations is not

100%, there are few data to demonstrate the magnitude of the problem. This could be an area of future research interest. Dan Odenweller has an experimental design for a such a study but has not been successful in obtaining the needed marked hatchery fish.

- *Indirect losses.* Indirect losses due to pumping have always been a concern but no studies have been conducted to quantify these losses and the mechanisms causing them. A typical estimate (and one mentioned in a memo commenting on the workshop) is that indirect losses are 5 to 10 times the direct losses, although the source of that estimate and the putative mechanisms were not described. Using the conservative 5X value, this means that indirect and direct losses of winter chinook numbered about 250,000 juveniles in 2000–2001. These calculations are included simply to demonstrate the need for a systematic, mass-balance approach to the question, an approach using all available data.

- *Statistical reliability.* When discussing data and data analyses, biologists often calculate a level of significance expressed as a percent. The idea is to set the level of significance to a low level, reducing the probability of rejecting the null hypothesis when it is true, that is, a Type I error. However, in the practical situation faced by the DAT biologists, it may be more important to minimize the probability of Type II error, that is, failing to reject the null hypothesis when it is false. In other words, the thresholds for detecting real effects of flows and other environmental conditions are often set too high. Given the high variability in the data being used to make these decisions, it is important to work toward approaches to determine the most likely models, rather than to apply restrictive statistical practices more appropriate to controlled experiments.

Population Level Benefits of EWA Actions

Several workshop participants expressed concern, either in the workshop or in post-workshop written comments, about the lack of an understanding of the benefits of EWA actions to the population as a whole. We believe that this concern, though valid, applies more to the complexity of the problems facing salmonid biologists than to the DAT–EWA process. DAT biologists had a limited set of tools, time, and data to make difficult daily operational recommendations. Deliberations usually resulted in curtailing pumping for a few days to reduce take. Technical analyses that support the hypothesis that pumping reductions significantly benefit survival of Sacramento River outmigrants through the Delta are shaky at best.

More work is needed in all aspects of salmon biology, from the egg to the ocean and return, to help identify the benefits of potential actions in and upstream of the Delta to salmon populations. This work could take the form of additional analyses on such rich data sets as the returns of marked juvenile salmon released from the Coleman National Fish Hatchery and the Feather River Hatchery. Additional research should also be considered. In this, and other instances where such research and analyses are contemplated, we should invite salmon experts from the Northwest, Alaska and Canada to help formulate the questions, hypotheses and study methods. We must be able to provide managers with a good idea of the effectiveness of public fund expenditures in helping restore and maintain salmonid populations. In the final analysis, biologists must be able to demonstrate population level benefits resulting from the expenditure of EWA and other assets.

Steelhead

Although steelhead is listed by NMFS, there are few sound data on which to make recommendations for use of EWA assets to protect this species. General assumptions are that juvenile steelhead move though the Delta at about the same time as juvenile chinook, and that protective measures for salmon will protect steelhead. Now that all hatchery steelhead are marked with clipped adipose fins, we should be able to better assess the movement of wild steelhead through the rivers and Delta. Because juvenile steelhead are much larger than most salmon and should therefore be affected less than salmon, we may be able to use the chinook salmon screen efficiency, handling and trucking, and prescreen loss estimates as conservative estimates for steelhead. In any event, more attention should be devoted to this species in salmonid analyses and EWA evaluations.

Research Recommendation

We strongly recommend that the CALFED Science Program establish a workgroup to assess salmonid research and data needs and to recommend a field and analytical research program. The workgroup could be established under the auspices of the Science Board or report directly to the Science Leader. The workgroup would consist of local and outside experts well versed in salmon ecology and quantitative analytical procedures. CALFED would appoint one or more chairs and establish a timeline for program development. The group would work with IEP and others to implement recommended research and monitoring programs.

Appendix A: Agenda

EWA Salmonid Workshop Agenda
June 21, 2001
Putah Creek Lodge, University of California–Davis

0830–0845	Introduction—Workshop Objectives/Groundrules	Kimmerer
0845–0915	EWA Basics and DAT Process for Using EWA for Salmonids	White
0915–1015	Data Collection and Interpretation	Greene, McLain
1015–1030	**Break**	
1030–1115	Scientific Justifications for EWA Actions	Brandes
1115–1200	Chronology of 2000–2001 Actions	Greene
1200–1230	**Lunch (provided)**	
1230–1345	Evaluation of Salmonid Benefits in 2000–2001	McLain, Greene, Brandes, Lindley
1345–1350	Topics Related to 2001 Experience with Winter-run Chinook Salmon	
	Introduction	Kimmerer
1350–1440	Historical Procedure for Establishing Annual Incidental Winter-run Take Limit	Oppenheim
	More Recent Information Relevant to Estimating Winter-run Escapement and Production	Snider
	Derivation and Adaptation of the Incidental Take Limit	Oppenheim
1440–1510	Topics Related to Salmon Loss Determination	
	Estimating Salmon Loss at the SWP and CVP Facilities	Foss
	Determination of Pre-screen Loss	Odenweller
1510–1525	**Break**	
1525–1625	General Discussion/Q&A between Speakers and Audience	
1625–1725	Status and Future Needs of EWA Evaluation	Chaired by Kimmerer
	Agency Perspective	Aceituno, Thabault, Jacobs
	Stakeholder Perspective	Swanson, Sitts
	Science Advisors Perspective	Kimmerer
	Lead Scientist Perspective	Taylor
	Note: Each speaker will have about 5 minutes to present a perspective on the 2001 and future EWA evaluations and information needs followed by discussion among panel members and the audience.	
1725–1745	What's Next?	Taylor, Kimmerer, Kjelson
1745–1900	Hosted Reception	

Appendix B: List of Attendees

Wim Kimmerer	Romberg Tiburon Center
Sam Luoma	CALFED/USGS
Kim Taylor	CALFED/USGS
Randy Brown	CALFED
Dave Fullerton	CALFED
Larry Brown	USGS
Bruce Herbold	EPA
Bruce Oppenheim	NMFS
Steve Lindley	NMFS
Mike Aceituno	NMFS
Gary Stern	NMFS
Beth Campbell	NMFS
Tracy Pettit	DWR
Brad Cavallo	DWR
Zach Hymanson	DWR
Sheila Greene	DWR
Erin Chappel	DWR
Lenny Grimaldo	DWR
Gail Newton	DFG
Jim White	DFG
Dan Odenweller	DFG
Steve Foss	DFG
Alice Low	DFG
Randy Benthin	DFG
Allen Grover	DFG
Michael Lacy	DFG
Scott Cantrell	DFG
Dale Mitchell	DFG
Bill Snider	DFG
Rob Titus	DFG
Rhonda Reed	DFG
Dennis McEwan	DFG
Diana Jacobs	DFG
Doug Morrison	USFWS
Ryan Olah	USFWS
Dan Buford	USFWS
Rick Morat	USFWS
Matt Brown	USFWS
Mike Thabault	USFWS
Dan Castleberry	USFWS
Andy Hamilton	USFWS
Roger Guinee	USFWS
Matt Vandenberg	USFWS
Marty Kjelson	USFWS
Pat Brandes	USFWS
Jeff McLain	USFWS
Paul Cadrett	USFWS
Mark Pierce	USFWS
Gonzalo Castillo	USFWS
Erwin Van Nieuwenhuyse	USFWS
Dave Robinson	USBR
Ken Lentz	USBR
Nick Hindman	WAPA
Joe Miyamoto	EBMUD
Felix Smith	Stakeholder
BJ Miller	San Luis and Delta-Mendota Water Authority
Anitra Pawley	The Bay Institute
Tina Swanson	The Bay Institute
Rick Sitts	MWD
Dick Daniel	CH2MHILL
Ron Yoshiyama	UC Davis

Appendix C: Fish Action 2

State of California The Resources Agency

Memorandum

Date : January 31, 2001

To : Management Agencies

Project Agencies

From : Department of Water Resources

Subject: **Fish Action: January 27 through January 31, 2001**

Description of Action

Per the CALFED Operations Juvenile Salmon Protection Plan, exports may be reduced to approximately 6,000 cfs combined for a five-day period when the Knights Landing or Sacramento Catch Index reaches a value of 10. Continued curtailment could be based upon continuous high index values or daily losses greater than 25 of chinook salmon at the CVP/SWP diversions in the south Delta. A multi-purpose five-day reduction in exports took place from January 17 to January 21 based upon the Sacramento Catch Index exceeding 10. Exports were increased on January 21 and again on January 22 and, since then, on at least three days, daily chinook salmon losses greater than 25 have occurred. The schematic for the Juvenile Salmon Protection Plan indicates use of salmon loss levels greater than 25 at the CVP/SWP to trigger the continuation of an export curtailment even if the Sacramento or Knights Landing Catch Index drops below 10 which has been the case during the past week. The Sacramento Catch Index was 6.7 on January 25 and 9.7 on January 26.

Based upon the loss level of juvenile chinook salmon in recent days, the Management Agencies requested a five-day reduction in combined exports to 6,000 cfs beginning January 27 and ending January 31. The majority of the export reductions would occur at the SWP since that is mainly where the losses occurred. The purpose of the action is to reduce the loss of juvenile chinook salmon and steelhead at the CVP/SWP Delta diversions and to otherwise improve the survival of juvenile salmon and steelhead in the Delta.

On January 26, a Data Assessment Team (DAT) conference call was made with representatives from the Management and Project Agencies in which the above actions were discussed. Mutual concurrence at the staff level to implement the proposed action was received. The notes from the DAT meeting are included.

Monitoring results and salmon and steelhead salvage/losses were re-evaluated on January 29 during a DAT conference call. After discussing the status of fish movement and losses over the weekend, the Management Agencies decided to continue the curtailment through January 31.

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Management Agencies
January 31, 2001
Page 2

Per the CALFED Operations Juvenile Salmon Protection Plan, the Delta Cross Channel gates will be closed for four days beginning January 26 based upon the Sacramento Catch Index being greater than 5. It is unlikely the gates would be opened on January 30 for two reasons: the gates are closed for the high Sacramento River flows at Freeport which peaked at about 29,000 cfs on January 28 and the gates must be closed on February 1 per D-1641.

Estimated Cost Of Action

The Department of Water Resources has estimated that these actions could reduce combined Central Valley Project and State Water Project exports by approximately 56 TAF (about 12 TAF for CVP and 44 TAF for SWP). The estimate assumes exports would continue at a combined level approximately between 11,600 and 11,900 cfs in the base operation. The actual amount could be either more or less dependent upon the flow in the San Joaquin River at Vernalis. However, if the export curtailment were reduced by two days, the estimate would be lower. DWR and the Bureau of Reclamation have not performed a cost analysis of the change in operations.

Method Of Accounting For Costs

DWR and Reclamation will provide to the Management Agencies an accounting of the actual water, energy, storage and conveyance costs. The water cost analysis will be provided within thirty days of completing the action and will include a comparison between the actual operation (with the fish action) and a base operation (based on planned exports). All other costs will be submitted thirty days upon completion of the recovery actions. Disagreements regarding the analysis are to be discussed within the B2/EWA Interagency Team. Disputes will be reviewed by the Ops Group and elevated to the Water Operations Management Team for final resolution.

B(2)/EWA Assets

The Management Agencies have concluded that this may be a joint CVPIA/EWA action. Therefore, both b(2) and EWA assets may be applied to the export reductions of the CVP and SWP. The proposed fish action is not to impact the baseline delivery capability of the SWP. Whether the action would impact the CVP delivery capability depends upon the amount of b(2) water used. Therefore, DWR is

Management Agencies
January 31, 2001
Page 3

to make operations and water allocation decisions based upon the base operations plan, absent the fish action, whereas, Reclamation is to make operations and water allocation decisions based upon the b(2) operations plan.

There are adequate CVPIA and EWA assets available to cover both January Delta fish actions. The amount of water and the time it becomes available will be determined when DWR/Reclamation submit the final water cost analysis to the Management Agencies.

	Chester V. Bowling
Carl Torgersen, Chief	Chester Bowling, Operations Manager
Operations Control Office	Central Valley Operations
Division of Operations and Maintenance	Bureau of Reclamation
Date ________________	Date 2/5/01

Management Agency Authorization provided by:

Department of Fish and Game – Perry Herrgesell
U.S. Fish and Wildlife Services – Michael Thabault
National Marine Fisheries Services – Michael Aceituno